

# INSECTICIDAL AND PISCICIDAL PLANTS OF INDIA

BY

COL. SIR R. N. CHOPRA, C.I.E., M.A., M.D., SC.D.  
(Cantab.), F.R.C.P. (Lond.);

R. L. BADHWAR, B.SC. Hons., M.SC. (Pb.);

AND

S. L. NAYAR, M.SC.

*(Medicinal Plants and Food Poisons Inquiry, Imperial Council of Agricultural Research, School of Tropical Medicine, Calcutta.)*

The discovery and application of cheap insecticides for the diverse needs of agriculture, destruction of household pests, and preventing of vectors of malaria and similar insect-borne diseases play a very important part in the economy of nations at the present day. At a moderate estimate the total annual loss to India through insect pests has been computed at roughly 2,000 millions of rupees and over a million and a half of human lives. Added to this is the fact that, in spite of all efforts to the contrary, advances in civilization are producing conditions specially suited for insect multiplication in most areas.

Most of the insecticides used in India at present are very expensive as they have to be imported from foreign countries. Further, owing to shipping difficulties and the rise in prices due to war conditions, the situation has become so acute that even ordinary well-to-do people are unable to afford these protective remedies against the ravages of insects. The great masses of India, whose economic condition is proverbially low, could ill-afford to use the costly imported commodities even before the outbreak of war while the present-day prices are entirely beyond their means. The ever-increasing demands of the large fighting forces has further made it imperative to fall back on the easily available indigenous supplies which may replace the imported materials. The Medicinal Plants and Food Poisons Inquiry has of late received many inquiries from various parts of India and overseas for information in regard to the medicinal and insecticidal plants of this country. Thanks to the foresight of the Imperial Council of Agricultural Research for financing this Inquiry six years ago, it is now possible to help with advice scientists, agriculturists, and commercial concerns interested in this field. Chopra and Badhwar (1) recently discussed the vast potential resources of the country in these directions and published a comprehensive survey of Indian plants poisonous to man, livestock, insects and fishes. Their studies revealed that a much larger number of potential insecticidal plants are available in India than in any other area of a similar size. In this paper we deal with the distribution, chemistry, and

other details with regard to the Indian insecticidal and piscicidal plants.

Arsenicals, lead and silicofluoride insecticides, etc., are very efficacious but have the serious drawback of being injurious to human beings and other warm-blooded animals generally. It is for this reason that increasing attention is being directed nowadays to insecticides of vegetable origin which, besides being effective against insects, are less harmful to man and animals. A large number of plants have been the subject of investigation in different countries, and, in this field of research, workers have taken advantage of the fact that quite a number of plants which are employed by the local natives as fish poisons from time immemorial have also been found to possess insecticidal properties. It is for this reason that we deal with the commonly recognized Indian insecticidal and piscicidal plants in this article, so that workers may be able to select plants for investigation from as large a list of suitable material as is known at the present day. The most outstanding results of the investigation of native fish poisons have been the discovery of the important insecticidal properties of certain species of *Derris*, *Lonchocarpus*, and *Tephrosia*. It does not, however, follow that, because a particular plant possesses piscicidal properties, it is necessarily of equal value as an insecticide. Pyrethrum, for example, which yields pyrethrin as its active constituents, is one of the very potent and widely used insecticides at the present day, but its use as a local fish poison is not recorded anywhere.

Biological investigations are very essential to evaluate the effect of insecticides on various kinds of insects, before any plant can be pronounced as a suitable insecticide. No plant must without detailed experimental data be regarded as universal insecticide, for, several which cause cent per cent mortality in one species of insects, may be less efficacious or even useless for others. Attention has recently been drawn to the fact that the total toxic effect of a mixture of two different insecticides is greater than the sum total of the individual effects of the two component insecticides taken independently (2). This phenomenon is known as synergism, *i.e.*, working together or co-operating, and is important not only from the point of view of increasing the efficiency of known insecticides by making suitable combinations, but also for the utilization of many insecticidal plants of Indian origin that may not be quite up to the standard when used alone.

#### IMPORTANT VEGETABLE INSECTICIDES

Among vegetable insecticides of proven value may be mentioned some species of *Chrysanthemum* (pyrethrum), *Derris* (tuba root), *Lonchocarpus* (cube root), *Tephrosia*, *Nicotiana* (tobacco), *Picrasma* (quassia), *Delphinium* (larkspur), *Veratrum*, etc. Of these *Chrysanthemum cinerariifolium* Vis. and *Derris elliptica* (Roxb.) Benth. have acquired great importance as plant insecticides during the last 15 years.

On account of the proved effectiveness of the flower-heads of *Chrysanthemum cinerariifolium* in destroying insects and mosquito larvae, Japan, Kenya, Yugoslavia, Brazil and some other countries



have taken up extensive cultivation of this plant. According to Holman (3), the total world production of pyrethrum flowers at the present time is probably over 15,000 tons. Various types of powders, dusts and sprays, with pyrethrum as the main insecticidal constituent, are available in the market for horticultural, household, and veterinary use. Recently the control of insect pests, which damage stored products in warehouses, has been successfully attempted with the help of pyrethrum sprays. At least two efficient aqueous base pyrethrum insecticides are now available in the market for destroying insects and mosquitoes in the interiors of aircraft, thus preventing the transmission of diseases, such as yellow fever, where for obvious reasons it is imperative to use non-inflammable spray (4). A very important use to which pyrethrum is being put nowadays is as a mosquito larvicide in antimalarial measures. A large number of the known larvicides are unsuitable for this purpose as they are definitely injurious to the aquatic vegetation and fishes in the areas treated, but a pyrethrum larvicide prepared according to a formula developed by Guisbug (5) is stated to be free from these disadvantages, and still a very useful larvicide.

As suggested by Chopra and Badhwar (6), outer temperate Himalayas and hill stations in other parts of India are likely to prove suitable for the cultivation of pyrethrum in this country; and it may be noted that the plant, on the whole, has grown well at altitudes of 5,000 to 6,000 ft., but it is advisable to avoid areas of high rainfall. A series of samples analyzed at the Calcutta School of Tropical Medicine from plants grown in Kashmir and the Murree Hills were found to be of as good a quality as any produced elsewhere. Both the total pyrethrin content of the flower-heads and biological tests compare favourably with the imported stuff. Large areas in the North-West Himalayas, especially in Kashmir, are available where good quality of pyrethrum could be grown in practically unlimited quantities and where ideal conditions for successful cultivation prevail. Amongst the attempts so far made for the cultivation of pyrethrum in India may be mentioned those at Baramulla and Tangmarg in Kashmir, Murree Hills, Kulu Valley, Palampur and Kasauli in the Punjab, Parachinar in the Kurrum Agency, North-West Frontier Province, the United Provinces, Bengal, Madras, and Mysore State. Cultivation has so far failed at Ranchi, Poona, Kasauli, and in Sind. The failure of pyrethrum germination at Kasauli in the Punjab and at Ranchi must be regarded as accidental, and further attempts to grow it are likely to meet with success.

*Derris elliptica* is found in Burma, Siam, Cambodia, Cochin-China and Malaya, and also in the East Indian Archipelago and the Philippines. It is found in India only to a limited extent in Chittagong. Practically all the tuba root of commerce is produced in Malaya, Dutch East Indies, Philippine Islands and Sarawak, where large-scale cultivation of the plant is carried out. It has also been successfully cultivated experimentally in other tropical countries, such as parts of East and West Africa, the Congo and West Indies. Of the other species of *Derris* examined, only *D. malaccensis* Prain has assumed commercial value equal in importance to *D. elliptica*, and is being largely cultivated. Experi-

mental cultivation of *D. elliptica* and *D. malaccensis* has been attempted in Travancore, the Punjab, Kashmir, Mysore, and Dehra Dun; that grown in Mysore has been found to contain up to 7 per cent of rotenone in its roots, which is encouraging. Over 20 species of *Derris* are found in India, several of these growing abundantly. There is a great possibility that some of these at least may prove to be of important insecticidal value. Of the Indian species so far examined, only *D. ferruginea* (Roxb.) Benth. has been shown to contain rotenone, and may prove a good insecticide. A number of species of *Derris* are known to be used extensively in tropical countries for catching fish. The crushed portions of these plants thrown into streams and ponds stupefy fishes, and make them float up to the surface.

Of other plants containing rotenone and allied compounds, mention may be made of species of *Lonchocarpus*, *Tephrosia*, and *Mundulea*, which, like derris, are locally used as fish poisons. Some species of *Lonchocarpus*, such as the cube root (*L. utilis* A.C. Smith and *L. uruca* Philip and Smith) have assumed importance as insecticides equal to that of derris. Commercial supplies of both *L. utilis* and *L. uruca* at present are obtained only from Peru and Brazil, where their cultivation is being successfully carried out. No attempts so far have been made to cultivate any of the cube roots in India, but there seems little doubt that successful plantations could be raised in Bengal and the Madras Presidency. Some of the foreign species of *Tephrosia* have been shown to possess marked insecticidal properties, while others have been found to be of little or no value. *T. vogelii* Hook. f. has been shown in Africa to be an efficient insecticide for fleas, lice and ticks, and has been suggested as a cheap commercial dip for cattle. *T. vogelii* is largely cultivated in the tea gardens of Assam for use as a nitrogenous manure. Chopra and collaborators (7) have recently found that the leaves of the Assam-grown plants do not possess insecticidal properties to any marked degree. It is possible, however, that this conclusion may have to be modified when leaves plucked at various times of the year are examined. Its seeds, which are stated to be the most toxic part of the plant, have not been investigated so far. *Mundulea sericea* (Willd.) Greenway (*M. suberosa* Benth.) is extensively found in South India; some samples of its leaves, bark, seeds, and root have been shown to be fairly toxic to certain types of insects (3).

Tobacco and its preparations in the form of sprays, dusts and fumigants are widely used as insecticides in horticultural and to some extent in veterinary practice. The very simple but quite efficient method used in many places is to prepare tobacco extracts by soaking or macerating tobacco leaves in water. In fact, a large proportion of the insecticides based on nicotine consists of crude tobacco extracts. Other insecticides prepared from tobacco contain nicotine sulphate, nicotine tannate, nicotine bentonite, etc. Nicotine is generally regarded as a contact insecticide, but it appears to act principally as a fumigant and sometimes as a stomach poison. Tobacco (both *Nicotiana tabacum* Linn. and *N. rustica* Linn.) is extensively cultivated in India, and the agriculturists should be educated to use it against insect crop pests.



Quassia (*Picrasma excelsa* Planch.), a foreign species, is also used as an insecticide, and there is every likelihood that some of the allied Indian species possess similar properties. We have recently been informed that powdered young leaves and twigs of *P. javanica* Blume, var. *nepalensis* (Benn.) Badhwar *nov. comb.* (*P. nepalensis* Benn.) are used to destroy mosquito larvae in Assam.

Several Indian species of *Delphinium* are even now used for destroying maggots in wounds and may be potential insecticides. It has also been stated that the alkaloid cytisine is an important constituent of the Persian and Australian insect powder. This alkaloid, which resembles nicotine in its action, has been found in at least six genera of which *Euchresta* and *Sophora* are represented in India. The rhizomes of hellebores (*Veratrum album* Linn. and *V. viride* Ait.), both foreign plants, are quite efficient insecticides, but they have failed to survive the introduction of rotenone-containing insecticides, and are very seldom used nowadays.

#### INSECT-REPELLENT PLANTS

The importance of insect-repellent plants in the economy of nations is obvious. The cheaper and larger the number of effective insect repellents that could be used from amongst the common indigenous plants, the greater the likelihood of the masses of India benefiting from their use. The leaves of neem (*Azadirachta indica* A. Juss.) and of patchouli (*Pogostemon heyneanus* Benth., syn. *P. patchouli* Fl. Brit. Ind., *non* Pellet.), and the roots of costus (*Saussurea lappa* C. B. Clarke) are used to protect woollen fabrics from insects. Articles placed in boxes made of sandalwood (*Santalum album* Linn.) are immune from the attacks of these pests. Some essential oils, such as the eucalyptus oil from *Eucalyptus globulus* Labill. and citronella oil from *Cymbopogon nardus* (Linn.) Rendle (*Andropogon nardus* Linn.), when applied to the body, give relief from the bites of mosquitoes so long as the odour lasts. Hemp (*Cannabis sativa* Linn.), if spread under a bedsheet, affords ample protection against fleas which disturb sleep at night in many of the hill stations of India. The simple device of mixing of the leaves of *Trigonella foenum-graecum* Linn., *Vitex negundo* Linn., etc., with the grains before storage, especially during the rainy season, as practised by the agriculturists in some parts of this country, saves the produce from the ravages of insects. All these plants contain essential oils, which are well known for their repellent or attracting properties for different kinds of insects. Research is being directed nowadays for finding suitable essential oils for use against particular insects. Pine oil in dilute solution appears to have repellent properties and is being increasingly used as an ingredient of plant sprays, household fly sprays, and cattle sprays. It has a greater solvent power for rotenone than mineral oils, and is believed to possess the important property of increasing the toxicity of pyrethrin and rotenone. Similarly, citronella oil, eucalyptus oil, and oil of wintergreen constitute one of the ingredients for several sprays. The use of repellent sprays for protecting cattle from the attacks of flies nowadays constitutes an integral

part of routine protective measures in all progressive countries of the world, although opinion appears to be still divided as to whether the protection thus afforded results in an actual increase in the yield of milk. Sen (8) reports that the use of a spray consisting of high-speed Diesel oil, 'Pyrocide 20' (a concentrated extract of pyrethrum flowers), and pine oil, when applied on Sahiwal cows for 21 consecutive days proved very effective against some species of biting flies, and resulted in an appreciable increase in the yield of milk. Investigation of suitable plants which, when grown, will keep away mosquitoes from habitations has been engaging the attention of malariologists for some time. No really effective plant for this purpose has so far been discovered but extended trials with the shrubby basil (*Ocimum gratissimum* Linn.), absinthe (*Artemisia absinthium* Linn.), and other plants, which diffuse strong fragrance in the surrounding atmosphere, are likely to yield valuable results.

#### CONTROL OF MOSQUITO LARVAE BY VEGETATION

Hackett, Russell and others (9) have discussed the naturalistic methods practised for the control of mosquito larvae, and have referred to the role of plant kingdom in this connection. It is stated that pollution by vegetable matter in the form of industrial wastes has often been tried with success as an antimalarial measure. Bagasse from sugarcane mills in the Philippines in one reported case seemed to keep a stream free from *Anopheles flavirostris*; the refuse from the Government Sisal Experiment Station is said to have a similar action, and numerous large pits used for macerating canepa hemp in Italy did not breed anophelines. Stagnant pools, such as engineering borrow-pits into which green-cut vegetation has been thrown are stated to breed culicines only, as no anophelines were found. The lethal effect of a fortnight-old brew of cut grass is said to be remarkable. The extension of this method in the form of 'herbage-packing' to shallow, small volume running channels has been advocated by Williamson and these authors. They are of the opinion that the effect is biological and not mechanical, and advocate the use of green-cut vegetation only, for dry straw results in a hay infusion favourable to larval growth. It is not every plant, however, that is suitable for use in running waters. According to these authors: 'The best so far found in India are *Cleistanthus* species and *Holorrhena antidysenterica* (sic). The first of these are fish poisons; the latter contains several alkaloids'. We are confident, however, that many more plants mentioned in the conspectus, which is appended, would be found to be equally good or even better for this purpose. The piscicidal plants cannot, however, be used if the waters contain fishes, or drain into tanks or reservoirs which contain such animal life.

#### PLANTS POISONOUS TO FISHES

For centuries, vegetable products of diverse nature have been used in different parts of the world for poisoning or stupefying



fishes in streams, ponds and pools for facilitating their capture. Wholesale poisoning of fishes by means of these plants is very uneconomical and is not allowed in any civilized country, but cases are known where such plants have come into contact with water and enormous number of fishes have died as a result. As pointed out already a knowledge of the local fish poisons has assumed a great importance in modern times, and a systematic investigation of these plants is gradually leading to discoveries of several potent insecticides. A comprehensive list of Indian piscicidal plants was published by Chopra (18) and lately considerable additions to it have been made by Chopra and Badhwar (1).

#### POTENTIALITIES IN INDIA

India with its great variety of climatic and edaphic conditions is particularly well suited for the cultivation of almost every plant. Vegetable insecticides of such proved value as pyrethrum and derris can be extensively grown in a number of suitable areas. The indigenous vegetation also abounds in potential insecticides and insect repellents, and a search from amongst the resources existing in this vast country will repay scrutiny. A list of those already in use as insecticides and insect repellents, as well as of those which are reputed to have piscicidal properties, is given below. The distribution of such plants in India, their active principles and properties and uses are also briefly mentioned. In addition to the plants detailed in the list, a number of essential-oil-bearing plants could be usefully investigated, especially as insect repellents or for use as valuable adjuncts in sprays.

A perusal of the following conspectus shows that the family Leguminosae contains the largest number of reputed insecticidal plants. Other important families in this connection are: Araceae, Euphorbiaceae, Compositae, Solanaceae, Ranunculaceae and Rubiaceae. The family Leguminosae also contains the largest number of piscicidal plants, while other important families in this respect are: Euphorbiaceae, Rubiaceae, Sapindaceae and Thymelaeaceae.

NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
1. <i>Acacia pennata</i> (Linn.) Willd.	A large scrambling or climbing shrub found in the Central and Eastern Himalayas up to 5,000 ft.; also in Oudh, Bengal, Bihar, and in Central, Western and South India. Reported from the North-West Himalayas.	.....	The fruits and stems are used in Burma to poison fish (10).
2. <i>Acerus calamus</i> Linn.	A semi-aquatic herb found throughout India in marshes or on river banks, wild or cultivated, up to 8,000 ft. on the Himalayas.	An essential oil in all parts (11, 12, 13). A glucosidic bitter substance in rootstocks (14).	Aromatic rootstock used to protect clothes from insect attacks; in powder form effectively employed for destroying fleas in some parts of India.
3. <i>Acerus gramineus</i> Soland.	A semi-aquatic herb found in the Khasia Hills and Sikkim Himalayas between 4,000 to 6,000 ft.	Essential oil (15).	Rootstock used in China as an insectifuge and insecticide (16).
4. <i>Acronychia pedunculata</i> (Linn.) Miq. (Syn. <i>A. laurifolia</i> Blume)	A small tree found in Dehra Dun, Konkan, North Kanara, the hill forests of the Western Ghats of Madras Presidency up to an altitude of 6,000 ft., South Deccan slopes, Northern Circars, Orissa, Sikkim 3,000 to 4,000 ft., Khasia Hills up to 4,000 ft., Assam and Chittagong.	.....	Pammel (17) reports it to be a fish poison.
5. <i>Adina cordifolia</i> (Roxb.) Benth. & Hook. f.	A large deciduous tree found in the Sub-Himalayan tract from the Jumna eastwards, ascending to 3,000 ft. and extending throughout the moister regions of India. (Common in Western India, especially in the forests of Surat, Ratnagiri and Thana districts; also plentiful in Mysore, Upper Godavari and Bhandvara).	Bitter principle (18).	Juice employed to kill maggots in sores.



NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
6. <i>Agave americana</i> Linn.	A stout shrubby plant with a rosette of spiny leaves. A native of America; planted in parks and gardens throughout India.	Acrid volatile oil in the leaves (19). A crystalline saponin in the roots (20). Leaves likely to contain saponins.	Wall paper impregnated with juice of the leaves is said to be proof against the ravages of white ants (21). According to Pammel (17), the plant is used as a fish poison in some countries.
7. <i>Albizzia chinensis</i> (Osbeck) Merr. (Syn. <i>A. stipulata</i> Boiv.)	A large tree found throughout India, ascending to an altitude of 4,000 ft. in the Himalayas.	Saponin (20).	Pammel (17) records it as a fish poison.
8. <i>Albizzia procera</i> (Roxb.) Benth.	A tall tree found in the Sub-Himalayan tracts from the Junna eastwards; also in Bengal, Bihar and Orissa, Central Provinces, Bombay Presidency and South India, usually in moist places. Occasionally seen as an ornamental or roadside tree.	.....	Raizada & Varma (10), on the authority of Watt (21), state that the bark of this tree, if pounded and thrown into a pond, stupefies fish. We do not, however, find any such reference in his book which they quote. Kirtikar & Basu (16) mention that the leaves have insecticidal properties.
9. <i>Anacardium occidentale</i> Linn.	A small tree from South America; now established in the coastal districts of South India, Chittagong and the Andaman Islands.	A black, caustic, oily juice containing phenolic compound cardol, anacardic acid and an ether-soluble substance (22).	Juice used to protect timber, books, etc., from white ants.
10. <i>Anagallis arvensis</i> Linn.	An erect or procumbent annual found over the greater part of India up to an altitude of 8,000 ft. in the Himalayas. The red-flowered variety is found in Kashmir, but the blue-flowered one is more common in India.	Volatile oil (11) and two glucosidic saponins have been isolated from the herb, while the root contains cyclamin which is also a glucosidic saponin (20).	Used in India to intoxicate fish and to expell leeches from the nostrils of livestock.

<p>11. <i>Anamirta cocculus</i> (Linn.) Wight &amp; Arn.</p>	<p>A large climbing shrub found in Assam, Eastern Bengal, Oudh, Orissa, and Konkan southwards to Ceylon.</p>	<p>Picrotoxin in the seeds (20).</p>	<p>A kind of ointment prepared from the drupes employed as an insecticide. They are also used to poison fish.</p>
<p>12. <i>Andrachne cordifolia</i> Muell.-Arg.</p>	<p>An erect shrub met with in the temperate Himalayas from the Indus eastwards to Nepal at 4,000 to 8,000 ft.; common in shady places.</p>	<p>Hydrocyanic acid in the leaves (17).</p>	<p>Leaves believed by people in Jammu to have insecticidal properties. The powdered root-bark of <i>A. ovalis</i> Muell.-Arg. of Africa, used as a fly exterminator by the Zulus, after it is mixed with milk (19).</p>
<p>13. <i>Annona reticulata</i> Linn.</p>	<p>A small American tree. Cultivated, but not so extensively as the following species, <i>A. squamosa</i>.</p>	<p>An alkaloid anonaine in the bark (23).</p>	<p>Properties similar to <i>A. squamosa</i>.</p>
<p>14. <i>Annona squamosa</i> Linn.</p>	<p>An American tree about 20 ft. high. Cultivated and naturalized in several parts of India.</p>	<p>Seeds contain an oil and a resin which contains an acrid principle (21). Leaves and seeds contain an amorphous alkaloid (24).</p>	<p>The seeds, leaves and the immature fruit contain an acrid principle fatal to insects; the dried unripe fruit, powdered and mixed with gram flour, used for killing vermin and the seeds to kill body lice. The powdered seeds and an aqueous infusion of leaves have valuable insecticidal properties (25). Pammel (17) records the plant as a fish poison.</p>
<p>15. <i>Apama tomentosa</i> Engl. (Syn. <i>Bragantia tomentosa</i> Blume)</p>	<p>Herbaceous plant found in Assam and Manipur.</p>	<p>.....</p>	<p>Recorded as a fish poison (17).</p>
<p>16. <i>Arenga obtusifolia</i> Mart.</p>	<p>A Malayan palm, found in India only under cultivation.</p>	<p>.....</p>	<p>In the Philippine Islands it is used for poisoning fishes (16).</p>





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6. <i>Agave americana</i> Linn.	A stout shrubby plant with a rosette of spiny leaves. A native of America; planted in parks and gardens throughout India.	Acrid volatile oil in the leaves (19). A crystalline saponin in the roots (20). Leaves likely to contain saponins.	Wall paper impregnated with juice of the leaves is said to be proof against the ravages of white ants (21). According to Pammel (17), the plant is used as a fish poison in some countries.
7. <i>Albizzia chinensis</i> (Osbeck) Merr. (Syn. <i>A. stipulata</i> Boiv.)	A large tree found throughout India, ascending to an altitude of 4,000 ft. in the Himalayas.	Saponin (20).	Pammel (17) records it as a fish poison.
8. <i>Albizzia procera</i> (Roxb.) Benth.	A tall tree found in the Sub-Himalayan tracts from the Jumna eastwards; also in Bengal, Bihar and Orissa, Central Provinces, Bombay Presidency and South India, usually in moist places. Occasionally seen as an ornamental or roadside tree.	.....	Raizada & Varma (10), on the authority of Watt (21), state that the bark of this tree, if pounded and thrown into a pond, stupefies fish. We do not, however, find any such reference in his book which they quote. Kirtikar & Basu (16) mention that the leaves have insecticidal properties.
9. <i>Anacardium occidentale</i> Linn.	A small tree from South America; now established in the coastal districts of South India, Chittagong and the Andaman Islands.	A black, caustic, oily juice containing phenolic compound cardol, anacardic acid and an ether-soluble substance (22).	Juice used to protect timber, books, etc., from white ants.
10. <i>Anagallis arvensis</i> Linn.	An erect or procumbent annual found over the greater part of India up to an altitude of 8,000 ft. in the Himalayas. The red-flowered variety is found in Kashmir, but the blue-flowered one is more common in India.	Volatile oil (11) and two glucosidic saponins have been isolated from the herb, while the root contains cyclamin which is also a glucosidic saponin (20).	Used in India to intoxicate fish and to expell leeches from the nostrils of livestock.
11. <i>Anemirta cocculus</i> (Linn.) Wight & Arn.	A large climbing shrub found in Assam, Eastern Bengal, Oudh, Orissa, and Konkan southwards to Ceylon.	Picrotoxin in the seeds (20).	A kind of ointment prepared from the drupes employed as an insecticide. They are also used to poison fish.
12. <i>Andrachne cordifolia</i> Muell.-Arg.	An erect shrub met with in the temperate Himalayas from the Indus eastwards to Nepal at 4,000 to 8,000 ft.; common in shady places.	Hydrocyanic acid in the leaves (17).	Leaves believed by people in Jammu to have insecticidal properties. The powdered root-bark of <i>A. ovalis</i> Muell.-Arg. of Africa, used as a fly exterminator by the Zulus, after it is mixed with milk (19).
13. <i>Annona reticulata</i> Linn.	A small American tree. Cultivated, but not so extensively as the following species, <i>A. squamosa</i> .	An alkaloid anonaine in the bark (23).	Properties similar to <i>A. squamosa</i> .
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16. <i>Arenga obtusifolia</i> Mart.	A Malayan palm, found in India only under cultivation.	.....	In the Philippine Islands it is used for poisoning fishes (16).



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17. <i>Arisaema speciosum</i> (Wall.) Mart.	Tuberous herb found in the temperate Himalayas from Hazara to Sikkim and Bhutan at 7,000 to 10,000 ft.	Acrid juice.	Properties similar to <i>A. tortuosum</i> .
18. <i>Arisaema tortuosum</i> (Wall.) Schott	A tall tuberous herb found in the temperate and subtropical Himalayas from Simla to Bhutan at about 8,000 ft.; also in Khasia Hills, Manipur, Chota Nagpur, Ranchi and Parasnath. In Western India, met with in Konkan; and in the Madras Presidency in Rampa Hills at 4,500 ft., Horsleykonda at 4,000 ft., and in the Western Ghats at 3,000 to 4,000 ft.	Acrid juice.	The tubers are used to kill worms which infest cattle during the rainy season. A decoction from the tubers prepared from some other species of <i>Arisaema</i> also used to kill insects in India and abroad.
19. <i>Aristolochia bracteata</i> Retz.	A slender prostrate herb growing on the banks of the Jumna and the Ganges, and in Bundelkhand, Sind and Konkan. In the Madras Presidency found in the Northern Circars, the Deccan and Carnatic, on dry especially the black cotton soil. Its occurrence in Bihar is doubtful.	A nauseous volatile substance and an alkaloid (26).	Juice applied to foul and neglected ulcers to destroy insect larvae. The vernacular name, <i>kirimur</i> (insect killer), is expressive of this fact.
20. <i>Artemisia Absinthium</i> Linn.	An aromatic herbaceous perennial met with in Kashmir and Kurrum Agency at 5,000 to 7,000 ft.	Volatile oil (20), a bitter glucoside absinthin (27) and a bitter substance anabsinthin (20).	Used to protect garments from moths.
21. <i>Artemisia vulgaris</i> Linn.	A gregarious shrub-like herb found throughout the mountainous tracts of India, especially between 5,000 and 12,000 ft.	Yields an essential oil containing $\alpha$ -thujone, borneol, etc. (28).	Used to prevent moths and other insects from infesting clothes and furniture.

<p>22. <i>Asclepias curassavica</i> Linn.</p>	<p>A native of the West Indies; often grown in gardens and has become naturalized in many parts of India.</p>	<p>The herb contains the glucoside asclepiadin (29, 30). The roots contain vincetoxin (31), which closely resembles emetine in its physiological action (26).</p>	<p>Used to procure fish in the West Indies and in Queensland.</p>
<p>23. <i>Azadirachta indica</i> A. Juss. (Syn. <i>Mella azadirachta</i> Linn.)</p>	<p>A large evergreen tree planted all over India; doubtfully indigenous to the Jhelum Valley.</p>	<p>Amorphous bitter principle and a crystalline substance, margosopicrin. Seeds also contain a bitter fixed oil with objectionable odour due to the presence of sulphur compounds and some fatty acids (32).</p>	<p>Leaves largely employed to protect woollen fabrics and books from insect attacks.</p>
<p>24. <i>Balanites roxburghii</i> Planch.</p>	<p>A shrub or small evergreen tree found in the drier parts of India extending from South-East Punjab and Delhi to Sikkim, Bengal, Central India, Bombay Presidency and South India.</p>	<p>The flesh of the fruit contains about 7.2 per cent of saponins (33).</p>	<p>The bark is used in several places in India and by African Arabs as a fish poison.</p>
<p>25. <i>Bambusa arundinacea</i> Willd.</p>	<p>A common bamboo in Central and South India; cultivated in many places in North-West India and Bengal.</p>	<p>Benzoic acid and traces of cyanogenetic glucoside in shoots (34).</p>	<p>Shoots have lethal action on mosquito larvae (34).</p>
<p>26. <i>Barringtonia acutangula</i> (Linn.) Gaertn.</p>	<p>A small or medium-sized tree most plentiful in Bengal, especially near the coast beyond the tidal range. It is also frequently found in Kanara and Bombay along the banks of streams.</p>	<p>The fruits contain two saponins.</p>	<p>The bark is used to stupefy fish in many parts of India. The seeds and roots are also said to be used for the same purpose (26).</p>
<p>27. <i>Barringtonia asiatica</i> (Linn.) Kurz (Syn. <i>B. speciosa</i> Forst.)</p>	<p>A rather small or moderate-sized tree which is a native of the Andaman Islands, Singapore and Ceylon. It also occurs on the Southern Deccan Peninsula, but not in a wild state.</p>	<p>The active principle of bark is stated to be a volatile oil combined with a resin (21). The seeds contain 3.27 per cent of a glucosidic saponin, barringtonin, and 1 per cent of a substance designated as barringtonetin (35).</p>	<p>The plant possesses narcotic properties and stupefies fish without killing them. The seeds are also said to be a fish poison.</p>





NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
17. <i>Arisaema speciosum</i> (Wall.) Mart.	Tuberous herb found in the temperate Himalayas from Hazara to Sikkim and Bhutan at 7,000 to 10,000 ft.	Acerid juice.	Properties similar to <i>A. tortuosum</i> .
18. <i>Arisaema tortuosum</i> (Wall.) Schott	A tall tuberous herb found in the temperate and subtropical Himalayas from Simla to Bhutan at about 8,000 ft.; also in Khasia Hills, Manipur, Chota Nagpur, Ranchi and Parasnath. In Western India, met with in Konkan; and in the Madras Presidency in Rampa Hills at 4,500 ft., Horsleykonda at 4,000 ft., and in the Western Ghats at 3,000 to 4,000 ft.	Acerid juice.	The tubers are used to kill worms which infest cattle during the rainy season. A decoction from the tubers prepared from some other species of <i>Arisaema</i> also used to kill insects in India and abroad.
19. <i>Aristolochia bracteata</i> Retz.	A slender prostrate herb growing on the banks of the Jumna and the Ganges, and in Bundelkhand, Sind and Konkan. In the Madras Presidency found in the Northern Circars, the Deccan and Carnatic, on dry especially the black cotton soil. Its occurrence in Bihar is doubtful.	A nauseous volatile substance and an alkaloid (26).	Juice applied to foul and neglected ulcers to destroy insect larvae. The vernacular name, <i>kirimar</i> (insect killer), is expressive of this fact.
20. <i>Artemisia Absinthium</i> Linn.	An aromatic herbaceous perennial met with in Kashmir and Kurrum Agency at 5,000 to 7,000 ft.	Volatile oil (20), a bitter glucoside absinthin (27) and a bitter substance anabsinthin (20).	Used to protect garments from moths.
21. <i>Artemisia vulgaris</i> Linn.	A gregarious shrub-like herb found throughout the mountainous tracts of India, especially between 5,000 and 12,000 ft.	Yields an essential oil containing $\alpha$ -thujone, borneol, etc. (28).	Used to prevent moths and other insects from infesting clothes and furniture.
22. <i>Asclepias curassavica</i> Linn.	A native of the West Indies; often grown in gardens and has become naturalized in many parts of India.	The herb contains the glucoside asclepiadin (29, 30). The roots contain vincetoxin (31), which closely resembles emetine in its physiological action (26).	Used to procure fish in the West Indies and in Queensland.
23. <i>Azadirachta indica</i> A. Juss. (Syn. <i>Melia azadirachta</i> Linn.).	A large evergreen tree planted all over India; doubtfully indigenous to the Jhelum Valley.	Amorphous bitter principle and a crystalline substance, margosopicrin. Seeds also contain a bitter fixed oil with objectionable odour due to the presence of sulphur compounds and some fatty acids (32).	Leaves largely employed to protect woollen fabrics and books from insect attacks.
24. <i>Balanites roxburghii</i> Planch.	A shrub or small evergreen tree found in the drier parts of India extending from South-East Punjab and Delhi to Sikkim, Bengal, Central India, Bombay Presidency and South India.	The flesh of the fruit contains about 7.2 per cent of saponins (33).	The bark is used in several places in India and by African Arabs as a fish poison.
25. <i>Bambusa arundinacea</i> Willd.	A common bamboo in Central and South India; cultivated in many places in North-West India and Bengal.	Benzoic acid and traces of cyanogenetic glucoside in shoots (34).	Shoots have lethal action on mosquito larvae (34).
26. <i>Barringtonia acutangula</i> (Linn.) Gaertn.	A small or medium-sized tree most plentiful in Bengal, especially near the coast beyond the tidal range. It is also frequently found in Kanara and Bombay along the banks of streams.	The fruits contain two saponins.	The bark is used to stupefy fish in many parts of India. The seeds and roots are also said to be used for the same purpose (26).
27. <i>Barringtonia asiatica</i> (Linn.) Kurz (Syn. <i>B. speciosa</i> Forst.)	A rather small or moderate-sized tree which is a native of the Andaman Islands, Singapore and Ceylon. It also occurs on the Southern Deccan Peninsula, but not in a wild state.	The active principle of bark is stated to be a volatile oil combined with a resin (21). The seeds contain 3.27 per cent of a glucosidic saponin, barringtonin, and 1 per cent of a substance designated as barringtonogenin (35).	The plant possesses narcotic properties and stupefies fish without killing them. The seeds are also said to be a fish poison.

NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
28. <i>Barringtonia racemosa</i> (Linn.) Roxb.	An evergreen ornamental tree common along the Western Coast from Konkan to Travancore and from the Sundarbans eastwards.	.....	The seed is used as a household vermifuge in Madagascar and is stated to be a fish poison (17). The plant possesses toxic and insecticidal properties (36).
29. <i>Berberis aristata</i> DC. (possibly some other species of <i>Berberis</i> also)	A robust shrub found in Garhwal, Jaunsar and Nepal.	.....	The plant is mentioned by Pammel as a fish poison (17).
30. <i>Butea monosperma</i> (Lam.) Kuntze (Syn. <i>B. frondosa</i> Koen. ex Roxb.)	A small or medium-sized tree common throughout the greater part of India up to 3,000, sometimes up to 4,000 ft.	Fixed oil, a small quantity of a resin and a large quantity of a water-soluble albuminoid in the seeds (18).	Maggots are killed by sprinkling the powdered seeds over them (16).
31. <i>Caesalpinia nuga</i> (Linn.) Ait.	A large prickly climber found on the banks of rivers near the coast, e.g., in Konkan, West Coast, Orissa, Sundarbans and Eastern Bengal near Chittagong, and in Sylhet.	.....	The pulped fruit and stems yield a fish poison (10).
32. <i>Callicarpa longifolia</i> Lam., var. <i>lanceolaria</i> C. B. Clarke	A shrub occurring plentifully in Central Bengal, Tippera, Chittagong and in the Khasia Hills up to an altitude of about 3,000 ft.	.....	Pammel (17) records <i>C. longifolia</i> as poisonous to fishes. It is likely that the variety <i>lanceolaria</i> also is a fish poison.
33. <i>Calonyction muricatum</i> (Linn.) G. Don (Syn. <i>Ipomoea muricata</i> Jacq.)	A large twiner found in the Himalayas from Kangra to Sikkim up to an altitude of 5,000 ft., and also in the Upper Gangetic Plain, Bengal and Deccan Hills; it is often cultivated for the sake of its thickened pedicels which are edible.	Seeds contain a resin (19).	The juice of the plant is used to destroy bugs (21).

<p>24. <i>Calophyllum</i> Linn.</p>	<p>An exceedingly handsome moderate-sized tree cultivated throughout India, especially near the sea, as an ornamental plant.</p>	<p>Saponins (17).</p>	<p>The plant according to Pammel is a fish poison (17).</p>
<p>35. <i>Cannabis sativa</i> Linn.</p>	<p>An aromatic resinous annual herb found in several parts of India on waste ground and by the roadside. In the Himalayas it grows wild and is widely distributed.</p>	<p>Resinous substance which contains about 33 per cent of a toxic red oil (37, 38, 39).</p>	<p>Has the property of driving away bugs. For this purpose, the leaves or the whole plant are scattered under the bedsheet, which is effective in getting relief from these pests.</p>
<p>36. <i>Careya arborea</i> Roxb.</p>	<p>A medium-sized tree frequently found in the Sub-Himalayan tract from the Jumna eastwards, and in Bengal, Central, Western and Southern India, ascending to an altitude of 5,000 ft.</p>	<p>The leaves and wood contain tannins, the former to the extent of 19 per cent (20).</p>	<p>The Mundas of Chota Nagpur use the root, bark and the leaves to kill fish (16). In Mysore the inner bark is rubbed on the shoes to ward off leeches and is said to be quite effective for this purpose.</p>
<p>37. <i>Casearia graveolens</i> Dalz.</p>	<p>A shrub or small tree found in the Upper Gangetic Plain, westwards to Chenab ascending to an altitude of 5,000 ft. and in Garhwal, Kumaon and the Deccan Peninsula. In Sikkim it is found at an altitude of 1,500 ft.</p>	<p>.....</p>	<p>The fruit is used to poison fish.</p>
<p>38. <i>Casearia tomentosa</i> Roxb.</p>	<p>A shrub or small tree common throughout India especially in open lands, ascending to 3,000 ft. in the Himalayas.</p>	<p>.....</p>	<p>According to Brandis, the fruit yields a milky acrid juice which is employed to poison fish (21). Sometimes the crushed fruit is used for the same purpose.</p>
<p>39. <i>Cassytha filiformis</i> Linn.</p>	<p>A wiry leafless twining parasite found throughout the greater part of India, especially near the seacoast.</p>	<p>Alkaloid (40).</p>	<p>According to Pappe, quoted by Watt and Breyer-Brandwijk (19), it has been used as a wash in 'scald head and for the destruction of vermin'.</p>





NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
28. <i>Barringtonia racemosa</i> (Linn.) Roxb.	An evergreen ornamental tree common along the Western Coast from Konkan to Travancore and from the Sundarbans eastwards.	.....	The seed is used as a household vermifuge in Madagascar and is stated to be a fish poison (17). The plant possesses toxic and insecticidal properties (36).
29. <i>Berberis aristata</i> DC. (possibly some other species of <i>Berberis</i> also)	A robust shrub found in Garhwal, Jaunsar and Nepal.	.....	The plant is mentioned by Pammel as a fish poison (17).
30. <i>Butea monosperma</i> (Lam.) Kuntze (Syn. <i>B. frondosa</i> Koen. ex Roxb.)	A small or medium-sized tree common throughout the greater part of India up to 3,000, sometimes up to 4,000 ft.	Fixed oil, a small quantity of a resin and a large quantity of a water-soluble albuminoid in the seeds (18).	Maggots are killed by sprinkling the powdered seeds over them (16).
31. <i>Caesalpinia nuga</i> (Linn.) Ait.	A large prickly climber found on the banks of rivers near the coast, e.g., in Konkan, West Coast, Orissa, Sundarbans and Eastern Bengal near Chittagong, and in Sylhet.	.....	The pulped fruit and stems yield a fish poison (10).
32. <i>Callicarpa longifolia</i> Lam., var. <i>lanccolaria</i> C. B. Clarke	A shrub occurring plentifully in Central Bengal, Tippera, Chittagong and in the Khasia Hills up to an altitude of about 3,000 ft.	.....	Pammel (17) records <i>C. longifolia</i> as poisonous to fishes. It is likely that the variety <i>lanccolaria</i> also is a fish poison.
33. <i>Calonyction muricatum</i> (Linn.) G. Don (Syn. <i>Ipomoea muricata</i> Jacq.)	A large twiner found in the Himalayas from Kangra to Sikkim up to an altitude of 5,000 ft., and also in the Upper Gangetic Plain, Bengal and Deccan Hills; it is often cultivated for the sake of its thickened pedicels which are edible.	Seeds contain a resin (19).	The juice of the plant is used to destroy bugs (21).
34. <i>Calophyllum inophyllum</i> Linn.	An exceedingly handsome moderate-sized tree cultivated throughout India, especially near the sea, as an ornamental plant.	Saponins (17).	The plant according to Pammel is a fish poison (17).
35. <i>Cannabis sativa</i> Linn.	An aromatic resinous annual herb found in several parts of India on waste ground and by the roadside. In the Himalayas it grows wild and is widely distributed.	Resinous substance which contains about 33 per cent of a toxic red oil (37, 38, 39).	Has the property of driving away bugs. For this purpose, the leaves or the whole plant are scattered under the bedsheet, which is effective in getting relief from these pests.
36. <i>Careya arborea</i> Roxb.	A medium-sized tree frequently found in the Sub-Himalayan tract from the Jumna eastwards, and in Bengal, Central, Western and Southern India, ascending to an altitude of 5,000 ft.	The leaves and wood contain tannins, the former to the extent of 19 per cent (20).	The Mundas of Chota Nagpur use the root, bark and the leaves to kill fish (16). In Mysore the inner bark is rubbed on the shoes to ward off leeches and is said to be quite effective for this purpose.
37. <i>Casearia graveolens</i> Dalz.	A shrub or small tree found in the Upper Gangetic Plain, westwards to Chenab ascending to an altitude of 5,000 ft. and in Garhwal, Kumaon and the Deccan Peninsula. In Sikkim it is found at an altitude of 1,500 ft.	.....	The fruit is used to poison fish.
38. <i>Casearia tomentosa</i> Roxb.	A shrub or small tree common throughout India especially in open lands, ascending to 3,000 ft. in the Himalayas.	.....	According to Brandis, the fruit yields a milky acid juice which is employed to poison fish (21). Sometimes the crushed fruit is used for the same purpose.
39. <i>Cosytha filiformis</i> Linn.	A wiry leafless twining parasite found throughout the greater part of India, especially near the seacoast.	Alkaloid (40).	According to Pappel, quoted by Watt and Breyer-Brandwijk (19), it has been used as a wash in 'scald head and for the destruction of vermin'.

NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
40. <i>Centratherum anthelminticum</i> (Willd.) Kuntze (Syn. <i>Vernonia anthelmintica</i> Willd.).	A tall annual met with throughout India up to 5,000 ft. on the Himalayas and Khasia Hills.	Bitter principle in the seeds (41).	In Travancore, the bruised seeds ground up into a paste with lime juice are largely employed for destroying pediculi in the head and body. The plant roasted in a room, or pounded and thrown about the floor, is believed to expel fleas; hence the popular English name, purple fleabane (21).
41. <i>Cerbera manghas</i> Linn. (Syn. <i>C. odollam</i> Gaertn.)	A small tree or a large shrub found throughout India in the salt swamps or on the seacoast. It is abundant on the Malabar coast but not very common in the Bombay Presidency and elsewhere.	The seeds contain a poisonous glucoside, cerberin, having a digitalis-like action.	Pammel (17) records the plant as a fish poison.
42. <i>Chrysanthemum cinerariifolium</i> Vis.	A glaucous perennial, experimentally cultivated in some parts of India, especially in the North-Western Himalayas.	Pyrethrin I and pyrethrin II in flower-heads (42). These, however, do not appear to be the only insecticidal principles in the plant, as watery extracts of the flower-heads are also toxic to mosquito larvae (43).	The flower-heads of pyrethrum have of recent years gained very great importance because of their insecticidal properties. They are employed in the form of powder or as a prepared extract for use as (a) household insecticides, (b) as livestock sprays, and (c) as horticultural dusts and sprays. Till recently Japan and Yugoslavia were the biggest producers of pyrethrum, but of late years Kenya is assuming increasing importance. It is also being grown



on a commercial scale in Persia, Algeria, Australia, Brazil, France, Spain and Switzerland.

Examination of various samples of flower-heads of *C. cinerariifolium* cultivated in Kashmir and Murree hills has shown 0.702 to 1.300 per cent of pyrethrins, which compares favourably with foreign-grown commodity which is imported. The biological tests against different species of mosquitoes and flies have also shown that the Indian-grown stuff compares favourably with the flower-heads imported from Japan and also with another powerful proprietary extract sold under the name of 'Pyroicide 20'. Thus both the chemical and biological tests carried out in connection with pyrethrum grown in India, lead to the conclusion that the cultivation of *C. cinerariifolium* should be extended at a rapid rate so that the large and growing demand for it in this country is met with (43).

A very important insecticide but not nearly as efficacious as *C. cinerariifolium*, at least in case of specimens grown in India (43).

43. *Chrysanthemum coccineum*  
Willd.

A glabrous perennial, experimentally cultivated in Murree and some other places in India.

See under *C. cinerariifolium*.



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41. <i>Cerbera manghas</i> Linn. (Syn. <i>C. odollam</i> Gaertn.)	A small tree or a large shrub found throughout India in the salt swamps or on the seacoast. It is abundant on the Malabar coast but not very common in the Bombay Presidency and elsewhere.	The seeds contain a poisonous glucoside, cerberin, having a digitalis-like action.	Pammel (17) records the plant as a fish poison.
42. <i>Chrysanthemum cinerariifolium</i> Vis.	A glaucous perennial, experimentally cultivated in some parts of India, especially in the North-Western Himalayas.	Pyrethrin I and pyrethrin II in flower-heads (42). These, however, do not appear to be the only insecticidal principles in the plant, as watery extracts of the flower-heads are also toxic to mosquito larvae (43).	The flower-heads of pyrethrum have of recent years gained very great importance because of their insecticidal properties. They are employed in the form of powder or as a prepared extract for use as (a) household insecticides (b) as livestock sprays, and (c) as horticultural dusts and sprays. Till recently Japan and Yugoslavia were the biggest producers of pyrethrum, but of late years Kenya is assuming increasing importance. It is also being grown
43. <i>Chrysanthemum coccineum</i> Willd.	A glabrous perennial, experimentally cultivated in Murree and some other places in India.	See under <i>C. cinerariifolium</i> .	on a commercial scale in Persia, Algeria, Australia, Brazil, France, Spain and Switzerland.  Examination of various samples of flower-heads of <i>C. cinerariifolium</i> cultivated in Kasbmir and Murree hills has shown 0.702 to 1.300 per cent of pyrethrins, which compares favourably with foreign-grown commodity which is imported. The biological tests against different species of mosquitoes and flies have also shown that the Indian-grown stuff compares favourably with the flower-heads imported from Japan and also with another powerful proprietary extract sold under the name of 'Pyroicide 20'. Thus both the chemical and biological tests carried out in connection with pyrethrum grown in India, lead to the conclusion that the cultivation of <i>C. cinerariifolium</i> should be extended at a rapid rate so that the large and growing demand for it in this country is met with (43).  A very important insecticide but not nearly as efficacious as <i>C. cinerariifolium</i> , at least in case of specimens grown in India (43).



NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
44. <i>Cimicifuga foetida</i> Linn.	A tall robust perennial found in the Himalayas from Kashmir to Bhutan at 7,000 to 12,000 ft.	Rhizomes of <i>C. racemosa</i> (Linn.) Nuttall, a foreign species, contain a saponin, a glucosidic tannin, a water-soluble glucoside, and a glucoside insoluble in water but soluble in alcohol (44). They also contain an essential oil. It is possible that the Indian plant contains identical or similar constituents.	The roots are used to drive away bugs and fleas in Siberia; the flowers and unripe fruits have an extremely foetid smell and probably have the same property; hence its English name, bugbane.
45. <i>Cinchona calisaya</i> Wedd.	A native of Bolivia and Peru, this species may be said to have succeeded well under Indian climatic conditions, and is largely cultivated in Sikkim at elevations of 1,500 to 3,000 ft. above sea level.	A number of alkaloids (about 20 in number), which resemble each other in their chemical and pharmacological properties, have been isolated from this and other species of <i>Cinchona</i> . The best known of these are quinine, quinidine, cinchonine and cinchonidine. Besides these alkaloids, cinchona bark contains a few free organic acids, tannins, some neutral substances, colouring matters, traces of volatile oil, etc.	According to Pammel (17), various species of <i>Cinchona</i> are poisonous to fishes.
<i>C. calisaya</i> Wedd., var. <i>ledgeriana</i> Howard	Cultivation of this variety is now being developed in all Indian plantations and is gradually replacing <i>C. succirubra</i> Pav. <i>ex</i> Klotzsch. It is largely cultivated in Java and yields the most plentiful supply of quinine of all the species.	Ditto.	Ditto.

<p>46. <i>Cinchona officinalis</i> Linn.</p>	<p>This species, with several varieties, is a native of Peru and Ecuador at an elevation of 5,000 to 7,500 ft. It is cultivated in South India in the Nilgiris near Ootacamund and thrives at higher altitudes (between 6,000 to 8,000 ft.) better than any other species. The cultivation of this species has been practically abandoned in Sikkim, as the climate is found to be too moist.</p>	<p>Ditto.</p>
<p>47. <i>Cinchona succirubra</i> Pav. <i>ex</i> Klotzsch</p>	<p>This plant is a native of Ecuador and is largely cultivated in South India at an altitude of 4,500 to 6,000 ft. It is also grown in the Government of Bengal Plantations at Mungpoo (Sikkim), and in parts of the Satpura Range in Central India. It has proved to be the hardiest and most easily cultivated species and succeeds well at altitudes of 3,000 to 6,000 ft.</p>	<p>Ditto.</p>
<p>48. <i>Cinnamomum camphora</i> Nees &amp; Eberm.</p>	<p>A small tree indigenous to Formosa, China and Japan; planted in some gardens in India up to 4,000 ft. in the North-West Himalayas.</p>	<p>Source of camphor.</p>
<p>49. <i>Cleistanthus collinus</i> Benth. &amp; Hook. <i>f.</i></p>	<p>A small tree found in the dry forests of Bundelkhand, Chota Nagpur, Central Provinces, Orissa, Northern Circars, Carnatic, the Deccan especially in Hyderabad, and Malabar.</p>	<p>The bark contains saponins and tannins (45).  The root, leaf, bark and fruit are employed as a poison for fish.</p>
<p>50. <i>Corypha umtraculifera</i> Linn.</p>	<p>A magnificent palm found in the moist forests of the Kumpta and Honavar talukas of North Kanara,</p>	<p>The young fruit is pounded up and used for stupefying fishes (46).  .....</p>



NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
44. <i>Cimicifuga foetida</i> Linn.	A tall robust perennial found in the Himalayas from Kashmir to Bhutan at 7,000 to 12,000 ft.	Rhizomes of <i>C. racemosa</i> (Linn.) Nuttall, a foreign species, contain a saponin, a glucosidic tannin, a water-soluble glucoside, and a glucoside insoluble in water but soluble in alcohol (44). They also contain an essential oil. It is possible that the Indian plant contains identical or similar constituents.	The roots are used to drive away bugs and fleas in Siberia; the flowers and unripe fruits have an extremely foetid smell and probably have the same property; hence its English name, bugbane.
45. <i>Cinchona calisaya</i> Wedd.	A native of Bolivia and Peru, this species may be said to have succeeded well under Indian climatic conditions, and is largely cultivated in Sikkim at elevations of 1,500 to 3,000 ft. above sea level.	A number of alkaloids (about 20 in number), which resemble each other in their chemical and pharmacological properties, have been isolated from this and other species of <i>Cinchona</i> . The best known of these are quinine, quinidine, cinchonine and cinchonidine. Besides these alkaloids, cinchona bark contains a few free organic acids, tannins, some neutral substances, colouring matters, traces of volatile oil, etc.	According to Pammel (17), various species of <i>Cinchona</i> are poisonous to fishes.
<i>C. calisaya</i> Wedd., var. <i>ledgeriana</i> Howard	Cultivation of this variety is now being developed in all Indian plantations and is gradually replacing <i>C. succirubra</i> Pav. ex Klotzsch. It is largely cultivated in Java and yields the most plentiful supply of quinine of all the species.	Ditto.	Ditto.
46. <i>Cinchona officinalis</i> Linn.	This species, with several varieties, is a native of Peru and Ecuador at an elevation of 5,000 to 7,500 ft. It is cultivated in South India in the Nilgiris near Ootacamund and thrives at higher altitudes (between 6,000 to 8,000 ft.) better than any other species. The cultivation of this species has been practically abandoned in Sikkim, as the climate is found to be too moist.	Ditto.	Ditto.
47. <i>Cinchona succirubra</i> Pav. ex Klotzsch	This plant is a native of Ecuador and is largely cultivated in South India at an altitude of 4,500 to 6,000 ft. It is also grown in the Government of Bengal Plantations at Mungpoo (Sikkim), and in parts of the Satpura Range in Central India. It has proved to be the hardiest and most easily cultivated species and succeeds well at altitudes of 3,000 to 6,000 ft.	Ditto.	Ditto.
48. <i>Cinnamomum camphora</i> Nees & Eberm.	A small tree indigenous to Formosa, China and Japan; planted in some gardens in India up to 4,000 ft. in the North-West Himalayas.	Source of camphor.	Camphor is used to protect woollen fabrics against insects and enters into the composition of several insecticidal preparations.
49. <i>Cleistanthus collinus</i> Benth. & Hook. f.	A small tree found in the dry forests of Bundelkhand, Chota Nagpur, Central Provinces, Orissa, Northern Circars, Carnatic, the Deccan especially in Hyderabad, and Malabar.	The bark contains saponins and tannins (45).	The root, leaf, bark and fruit are employed as a poison for fish.
50. <i>Corypha umbraculifera</i> Linn.	A magnificent palm found in the moist forests of the Kumpta and Honavar talukas of North Kanara,	.....	The young fruit is pounded up and used for stupefying fishes (46).



NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
50. <i>Corypha umbraculifera</i> Linn.—( <i>continued</i> .)	covering extensive areas near the Gairsoppa and Yena rivers, also on the Yellapur Ghats. It also occurs in Malabar and Travancore but in a doubtfully wild state. In the rest of tropical India it is occasionally cultivated.	.....	The seeds have an oil with properties similar to those of <i>C. tiglium</i> .
51. <i>Croton oblongifolius</i> Roxb.	A small deciduous tree found in the Sub-Himalayan tract from Oudh eastwards; also in Bengal, Sylhet, Chota Nagpur, and in the Central, Western and Southern India.	Seeds contain an oil which is the most violent of all cathartics. They also contain an alkaloid, ricinine, and two toxic proteins (20).	The oil is sometimes used as an insecticide. The fruit is employed in some foreign countries to poison fishes (17).
52. <i>Croton tiglium</i> Linn.	A small evergreen tree planted in gardens more or less throughout India; almost becoming naturalized in Bengal and Assam.	The fruits contain a proteolytic enzyme resembling erepsin (47). They are also found to contain a bitter substance, the nature of which has not been ascertained.	It has been said that the juice banishes woodlice and fish insects; freshly cut slices are strewn in their haunts for this purpose.
53. <i>Cucumis sativus</i> Linn. (wild form)	A hispidly hairy climber cultivated in all warm and warm-temperate countries. It is also found wild in Northern India.	Essential oil, alkaloid (18).	Turmeric is used to drive away ants by sprinkling in powder form on the ant holes. There are about fifteen species of <i>Curcuma</i> growing wild in India, and most of these could be used for similar purpose.
54. <i>Curcuma longa</i> Roxb.	A tuberous herb, extensively cultivated all over India for its rhizomes known as turmeric.		

<p>55. <i>Cymbopogon nardus</i> (Linn.) Rendle (Syn.) <i>Andropogon nardus</i> Linn.)</p>	<p>A tall aromatic grass cultivated for the sake of its aromatic oil. According to some authors, this plant is also found wild in India.</p>	<p>Essential oil known as oil of citronella obtained from the leaves.</p>	<p>The commercial supply of oil of citronella is obtained principally from Ceylon, Burma and the Straits Settlements. It is an important constituent of mosquito repellents found in the market.</p>
<p>56. <i>Cynanchum Arnotianum</i> Wight</p>	<p>An erect plant found in Kashmir at 6,000 to 8,000 ft.; also in Baluchistan.</p>	<p>.....</p>	<p>The leaves are dried and powdered, and used to destroy the maggots which infest wounds in animals.</p>
<p>57. <i>Dalbergia stipulacea</i> Roxb.</p>	<p>A large climbing shrub, often a small erect tree found in the Eastern Himalayas up to 4,000 ft.; also in Assam, Khasia Hills and Chittagong.</p>	<p>.....</p>	<p>The bark and root of this plant are stated to be used to poison fishes (10).</p>
<p>58. <i>Delphinium brunonianum</i> Royle</p>	<p>An erect simple herb found in the Western Himalayas and Tibet between 13,000 and 17,000 ft.</p>	<p>Note.—Various species of <i>Delphinium</i> contain alkaloids, such as ajacine, ajaconine, delcosine, delphinine, delphinoidine, staphisagrine, etc.; of these delphinine and staphisagrine are the most important. <i>D. brunonianum</i> and <i>D. caeruleum</i> have not been analyzed so far.</p>	<p>Aitchison (48) remarks that the juice of the leaves is used in Kurrum Agency to destroy ticks on animals, particularly when they affect sheep.</p>
<p>59. <i>Delphinium caeruleum</i> Jacquem. ex Cambess.</p>	<p>An erect herb met with on the alpine Himalayas from Kumaon to Sikkim; common in the Sutlej basin at 8,000 to 17,000 ft.</p>	<p>.....</p>	<p>The root is applied to kill maggots in the wounds of goats (21).</p>
<p>60. <i>Delphinium elatum</i> Linn.</p>	<p>Sparingly branched herb found in the temperate Western Himalayas from Kashmir to Kumaon and in the inner Tibetan Valleys at 10,000 to 12,000 ft.</p>	<p>Alkaloids (49).</p>	<p>In Europe the seeds are used as an insecticide (21).</p>



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50. <i>Corypha umbraculifera</i> Linn.—(continued.)	covering extensive areas near the Gairsoppa and Yena rivers, also on the Yellapur Ghats. It also occurs in Malabar and Travancore but in a doubtfully wild state. In the rest of tropical India it is occasionally cultivated.		
51. <i>Croton oblongifolius</i> Roxh.	A small deciduous tree found in the Sub-Himalayan tract from Oudh eastwards; also in Bengal, Sylhet, Chota Nagpur, and in the Central, Western and Southern India.	.....	The seeds have an oil with properties similar to those of <i>C. tiglium</i> .
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53. <i>Cucumis sativus</i> Linn (wild form)	A hispidly hairy climber cultivated in all warm and warm-temperate countries. It is also found wild in Northern India.	The fruits contain a proteolytic enzyme resembling erepsin (47). They are also found to contain a bitter substance, the nature of which has not been ascertained.	It has been said that the juice banishes woodlice and fish insects; freshly cut slices are strewn in their haunts for this purpose.
54. <i>Curcuma longa</i> Roxh.	A tuberous herb, extensively cultivated all over India for its rhizomes known as turmeric.	Essential oil, alkaloid (18).	Turmeric is used to drive away ants by sprinkling in powder form on the ant holes. There are about fifteen species of <i>Curcuma</i> growing wild in India, and most of these could be used for similar purpose.
55. <i>Cymbopogon nardus</i> (Linn.) Rendle (Syn. <i>Andropogon nardus</i> Linn.)	A tall aromatic grass cultivated for the sake of its aromatic oil. According to some authors, this plant is also found wild in India.	Essential oil known as oil of citronella obtained from the leaves.	The commercial supply of oil of citronella is obtained principally from Ceylon, Burma and the Straits Settlements. It is an important constituent of mosquito repellents found in the market.
56. <i>Cynauchum Arnottianum</i> Wight	An erect plant found in Kashmir at 6,000 to 8,000 ft.; also in Baluchistan.	.....	The leaves are dried and powdered, and used to destroy the maggots which infest wounds in animals.
57. <i>Dalbergia stipulacea</i> Roxb.	A large climbing shrub, often a small erect tree found in the Eastern Himalayas up to 4,000 ft.; also in Assam, Khasia Hills and Chittagong.	.....	The bark and root of this plant are stated to be used to poison fishes (10).
58. <i>Delphinium brunonianum</i> Royle	An erect simple herb found in the Western Himalayas and Tibet between 13,000 and 17,000 ft.	<i>Note.</i> —Various species of <i>Delphinium</i> contain alkaloids, such as ajacine, ajaconine, delcosine, delphinine, delphinoidine, staphisagrine, etc.; of these delphinine and staphisagrine are the most important. <i>D. brunonianum</i> and <i>D. caeruleum</i> have not been analyzed so far.	Aitchison (48) remarks that the juice of the leaves is used in Kurrum Agency to destroy ticks on animals, particularly when they affect sheep.
59. <i>Delphinium caeruleum</i> Jacquem. ex Cambess.	An erect herb met with on the alpine Himalayas and Kumaon to Sikkim; common in the Sutlej basin at 8,000 to 17,000 ft.		The root is applied to kill maggots in the wounds of goats (21).
60. <i>Delphinium elatum</i> Linn.	Sparsely branched herb found in the temperate Western Himalayas from Kashmir to Kumaon and in the inner Tibetan Valleys at 10,000 to 12,000 ft.	Alkaloids (49).	In Europe the seeds are used as an insecticide (21).



NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
61. <i>Derris elliptica</i> (Roxb.) Benth.	<p>A large, handsome climber reported from Kodala Hill near Chittagong.</p> <p>Commercial supply comes mostly from Malaya, Sarawak, British North Borneo, and the Dutch East Indies. Attempts being made to cultivate this plant in different parts of India, such as Travancore, the Punjab, Kashmir, Mysore and Dehra Dun.</p>	<p>Roots contain rotenone, deguelin, tephrosin, isotephrosin, toxicarol, dehydrorotenone and other substances; of these rotenone is said to be the most important (20, 50, 51, 52). In commercial assay of tuba roots the total resinous content is regarded as a measure of its toxicity irrespective of the amount of crystalline rotenone because noncrystalline resin is also equally toxic. The fine lateral roots have been stated to contain higher toxic content than the larger tap roots.</p>	<p>The root, known as tuba root or derris, is an important article of commerce on account of being a valuable horticultural and agricultural insecticide. It is useful against many caterpillars, probably all larvae of leaf-eating wasps, many beetles and their larvae, turnip fleas, flower wasps, plant lice and red spider. In animal husbandry it has proved very effective against the larvae of warble fly, poultry pests such as red poultry mite, and forms the basis of proprietary sheep dip.</p> <p>An insecticidal wash effective against a wide range of pests may be made by adding 1 lb. of powdered root and 4 oz. of soft soap to 1 gallon of water (50). The powdered root mixed with forty parts of talc makes a very good insect powder for dogs and cats.</p> <p>The toxicity of tuba roots varies with the age of the plant. Harvesting of plant about 23 months after planting is recommended.</p> <p>The tuba root is also poisonous to fishes.</p> <p><i>Note.</i>—Over twenty other species of <i>Derris</i> are found in India. It is very likely that a number of them possess piscicidal</p>

and insecticidal properties, and it would be worth-while investigating their properties. Besides the following species, only *D. robusta* (Roxb. *ex DC.*) Benth. has so far been investigated and shown to be devoid (53) of insecticidal properties.

Because of the presence of rotenone, it is very likely that this plant possesses piscicidal and insecticidal properties.

Used as a fish poison. Devoid of insecticidal properties (54).

The bark of this plant is used as a fish poison.

The plant possesses very poor insecticidal properties (54).

<p>62. <i>Derris ferruginea</i> (Roxb.) Benth.</p>	<p>A woody climber found in the ever-green forests of Upper Assam down to Darrang and Sibsagar.</p>	<p>Yields a fair amount of rotenone—up to 2.4 per cent (54, 55).</p>
<p>63. <i>Derris scandens</i> (Roxb.) Benth.</p>	<p>A very large climber found in the forests of North Oudh, Konkan, Kanara, Madras Presidency from Northern Circars southwards, Bengal especially near Chittagong, and Orissa. It is also sometimes cultivated in gardens.</p>	<p>.....</p>
<p>64. <i>Derris trifoliata</i> Lour., var. <i>uliginosa</i> (Roxb. <i>ex Willd.</i>) Badhwar <i>nov. comb.</i> (Syn. <i>D. uliginosa</i> Benth.; <i>Robinia uliginosa</i> Roxb. <i>ex Willd.</i>)</p>	<p>A large climber found on the muddy seacoast and creeks of the Bombay and Madras Presidencies and near the sea from Cuttack tidal forests to Puri (near the Chilka Lake); also in Sundarbans and Chittagong in Bengal, and in Assam.</p>	<p>Power (56) examined the stem-bark and found it to contain 9.3 per cent of tannic acid and some resins, and concluded that the toxic effects of the plant were probably due to some constituents of the resin. Krishna &amp; Ghose (54), who examined the roots in different seasons of the year, state 'the total ether extract of these roots which is supposed to extract most of the insecticidal principle, was found to vary from 1.2 to 1.9 per cent and although the ethersolubles gave distinct colour test for rotenone and allied bodies, no rotenone could be isolated'.</p>



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61. <i>Derris elliptica</i> (Roxb.) Benth.	<p>A large, handsome climber reported from Kodala Hill near Chittagong.</p> <p>Commercial supply comes mostly from Malaya, Sarawak, British North Borneo, and the Dutch East Indies. Attempts being made to cultivate this plant in different parts of India, such as Travancore, the Punjab, Kashmir, Mysore and Dehra Dun.</p>	<p>Roots contain rotenone, deguelin, tephrosin, isotephrosin, toxicarol, dehydrorotenone and other substances; of these rotenone is said to be the most important (20, 50, 51, 52). In commercial assay of tuba roots the total resinous content is regarded as a measure of its toxicity irrespective of the amount of crystalline rotenone because noncrystalline resin is also equally toxic. The fine lateral roots have been stated to contain higher toxic content than the larger tap roots.</p>	<p>The root, known as tuha root or derris, is an important article of commerce on account of being a valuable horticultural and agricultural insecticide. It is useful against many caterpillars, probably all larvae of leaf-eating wasps, many beetles and their larvae, turnip fleas, flower wasps, plant lice and red spider. In animal husbandry it has proved very effective against the larvae of warble fly, poultry pests such as red poultry mite, and forms the basis of proprietary sheep dip.</p> <p>An insecticidal wash effective against a wide range of pests may be made by adding 1 lb. of powdered root and 4 oz. of soft soap to 1 gallon of water (50). The powdered root mixed with forty parts of talc makes a very good insect powder for dogs and cats.</p> <p>The toxicity of tuha roots varies with the age of the plant. Harvesting of plant about 23 months after planting is recommended.</p> <p>The tuba root is also poisonous to fishes.</p> <p><i>Note.</i>—Over twenty other species of <i>Derris</i> are found in India. It is very likely that a number of them possess piscicidal</p>
62. <i>Derris ferruginea</i> (Roxb.) Benth.	<p>A woody climber found in the evergreen forests of Upper Assam down to Darrang and Sibsagar.</p>	<p>Yields a fair amount of rotenone—up to 2.4 per cent (54, 55).</p>	<p>and insecticidal properties, and it would be worth-while investigating their properties. Besides the following species, only <i>D. robusta</i> (Roxb. ex DC.) Benth. has so far been investigated and shown to be devoid (53) of insecticidal properties.</p>
63. <i>Derris scandens</i> (Roxb.) Benth.	<p>A very large climber found in the forests of North Oudh, Konkan, Kanara, Madras Presidency from Northern Circars southwards, Bengal especially near Chittagong, and Orissa. It is also sometimes cultivated in gardens.</p>	<p>.....</p>	<p>Because of the presence of rotenone, it is very likely that this plant possesses piscicidal and insecticidal properties.</p> <p>Used as a fish poison. Devoid of insecticidal properties (54).</p>
64. <i>Derris trifoliata</i> Lour., var. <i>uliginosa</i> (Roxb. ex Willd.) Badhwar <i>nov. comb.</i> (Syn. <i>D. uliginosa</i> Benth.; <i>Robinia uliginosa</i> Roxb. ex Willd.)	<p>A large climber found on the muddy seacoast and creeks of the Bombay and Madras Presidencies and near the sea from Cuttack tidal forests to Puri (near the Chilka Lake); also in Sundarbans and Chittagong in Bengal, and in Assam.</p>	<p>Power (56) examined the stem-bark and found it to contain 9.3 per cent of tannic acid and some resins, and concluded that the toxic effects of the plant were probably due to some constituents of the resin. Krishna &amp; Ghose (54), who examined the roots in different seasons of the year, state 'the total ether extract of these roots which is supposed to extract most of the insecticidal principle, was found to vary from 1.2 to 1.9 per cent and although the ether solubles gave distinct colour test for rotenone and allied bodies, no rotenone could be isolated'.</p>	<p>The bark of this plant is used as a fish poison.</p> <p>The plant possesses very poor insecticidal properties (54).</p>



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65. <i>Dioscorea hispida</i> Dennst. (Syn. <i>D. daemona</i> Roxb.)	A climbing plant found throughout India up to an altitude of 2,500 ft. in the Himalayas and up to 4,000 ft. in the Khasia and Naga Hills. It is, however, absent from the plains of Bengal.	Tubers contain an alkaloid called dioscorine (57), which runs through the whole plant (58).	In the Philippine Islands, poultices of the tubers are applied to wounds which are infested with maggots, to kill them (58). Fishes are stated to be poisoned by the tubers. According to Gimlette (59), the leaves are also used to poison fishes.
66. <i>Dioscorea prazeri</i> Prain & Burkill (Syn. <i>D. deltoidea</i> Wall., var. <i>sikkimensis</i> Prain)	A climbing plant found in the hill tracts of Northern Bengal, Nepal and Khasia Hills up to 5,500 ft.	Poisonous saponins (58).	The Lepchas use the rhizome of this plant as a substitute for soap for washing their hair, because it kills lice. They also employ it as a fish poison.
67. <i>Diospyros ebenum</i> Koen.	A large or moderate-sized tree found in the forests of Peninsular India and Assam.	.....	Pammel records it as a fish poison (17).
68. <i>Diospyros montana</i> Roxb.	A small or medium-sized tree found throughout India, e.g. in the Sub-Himalayan tract from Kangra eastwards, Upper Gangetic Plain, Bihar, Konkan, Southern Mahratta Country, Northern Circars, the Deccan, Carnatic and eastern slopes of the Ghats.	.....	The fruit is stated to be used by the hillmen of Travancore for poisoning fish (26). Crushed leaves are used for the same purpose in Chota Nagpur (16).
69. <i>Diospyros paniculata</i> Dalz	A middle-sized West Peninsular tree found in the forests of Southern Mahratta Country, Kanara, Malabar and Travancore up to 3,000 ft. above sea level.	.....	The leaves are used as a fish poison (16).

NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
138. <i>Ruta graveolens</i> Linn., var. <i>angustifolia</i> Hook. f.	Cultivated in gardens.	A volatile oil in the leaves, roots and seeds. Also a glucoside, rutin, and a coumarin-like odoriferous principle (19).	The plant is sometimes spread on beds to keep off insects.
139. <i>Santalum album</i> Linn.	A small evergreen tree, parasitic on roots to start with. Found in Mysore, Coorg, Coimbatore and Salem districts, southwards to Madura and northwards to Kolhapur; wild or cultivated.	Essential oil in the aromatic heartwood of the tree; also in roots.	The essential oil is an efficient insecticide and insect repellent. The wood is largely used in ornamental carving and cabinet work; its odour drives away insects and it is, therefore, of value for making chests and boxes. Small chips and raspings of the heartwood would serve the purpose of keeping off insects, when placed among clothes, at the same time imparting a pleasant odour.
140. <i>Sapindus mukorossi</i> Gaertn.	A handsome tree cultivated throughout North-West India, Bengal and Assam; also found wild in the Himalayas up to an altitude of 4,000 ft.	The fruits contain fairly large amounts of saponins—10.5 per cent (33).	The plant is described as a fish poison by Pammel (17).
141. <i>Sapindus trifoliatus</i> Linn.	A handsome tree common about the villages in South and West India; also cultivated in Bengal where it is doubtfully native. It is occasionally planted elsewhere also.	The pericarp contains a fairly large quantity of saponins—11.5 per cent (99). According to Brant, quoted by Walt (20), no saponins are contained in the stone	Pammel (17) records it as a fish poison. It is more than probable that <i>S. emarginatus</i> Vahl, which is treated as a synonym of <i>S. trifoliatus</i> in the Fl. Brit. Ind., but which is now regarded as distinct species, possesses similar properties. The fruits of both are

133. <i>Randia uliginosa</i> DC.	A small rigid tree found in the Eastern, Central and Southern India, but is not common northwards.	.....	The unripe fruit is used to intoxicate fish, and according to Watt (21), the bruised root is also employed for this purpose. The unripe fruits are employed for poisoning fish.
134. <i>Rauwolfia serpentina</i> Benth. ex Kurz	An erect shrub found in Sub-Himalayan tracts and in the plains near the foot of the hills from Sirhind eastward to Assam, ascending to an altitude of 4,000 ft.; also in Konkan, North Kanara, Southern Mahratta Country, Western and Eastern Ghats of the Madras Presidency (up to 3,000 ft.), many districts of Bihar such as Patna and Bhagalpur, and in North and Central Bengal.	Chemical analysis of the root has yielded five crystalline alkaloids which can be classified into two groups: (A) the <i>ajmaline</i> group— <i>ajmaline</i> , <i>ajmalinine</i> and <i>ajmalicine</i> ; and (B) the <i>serpentine</i> group— <i>serpentine</i> and <i>serpentinine</i> (97). Besides these, there are some more alkaloids present in both the <i>ajmaline</i> as well as the <i>serpentine</i> group.	Pammel (17) records this plant as a fish poison, but such use has not been observed by the present authors in India.
135. <i>Rhododendron barbatum</i> Wall. ex G. Don	A tree found in the temperate Himalayas from Kumaon to Bhutan at altitudes of 8,000 to 12,000 ft.; common in Sikkim.	Contains the toxic substance andromedotoxin (88).	The plant is mentioned by Chopra (18) to be a fish poison.
136. <i>Rhododendron falc oneri</i> Hook. f.	A tree common in the Himalayas from East Nepal to Bhutan at altitudes of 9,000 to 13,000 ft.	Contains a toxic substance, andromedotoxin (88).	Chopra (18) mentions the plant as a fish poison.
137. <i>Ricinus communis</i> Linn.	A tall stout annual, or perennial and sub-arboreous. Originally probably from America, it is now extensively cultivated for its oil-bearing seeds and has also become naturalized near habitations in many parts of India.	Seeds contain a fixed oil and a toxalbumin, ricin, which does not pass into the oil (98).	Castor oil is said to be an active poison for flies (98). Pammel (17) records the plant as a fish poison.



NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
129. <i>Polygonum hydriopiper</i> Linn.—( <i>continued</i> ).		Root said to contain oxymethyl-anthraquinones (93).	are informed that it is used as a fish poison in the Puriab hills. It is very likely that some other plants belonging to the genus <i>Polygonum</i> , especially <i>P. persicaria</i> Linn., possess similar properties.
130. <i>Pongamia pinnata</i> (Linn.) Merr. (Syn. <i>P. glabra</i> Vent.)	A moderate-sized almost evergreen tree met with all over India, on the banks of rivers and streams, especially near the seacoast and some forest localities; often planted as a roadside tree. It sometimes flowers as a shrub on the seacoast.	The seeds contain 27 to 36.4 per cent of a bitter fatty oil and traces of an essential oil (18).	The seeds and roots are said to be poisonous to fishes. A 2 per cent <i>P. glabra</i> oil-resin spray has been stated to be highly toxic against the nymph and adult stages of the green bug ( <i>Coccus viridis</i> ) on coffee (94).
131. <i>Pygeum gardneri</i> Hook. f.	A medium-sized tree found in the Western Ghats of Madras and Bombay Presidencies, in the hills of Travancore, Malabar, Nilgiris, Pulneys, the Deccan, Southern Mahratta Country, and Konkan at altitudes above 3,000 ft.; common on the Mahableshwar plateau.	The seeds smell strongly of hydrocyanic acid.	The kernel of the fruit is used as a fish poison.
132. <i>Randia dumetorum</i> Lam. [Split up into three species by Gamble (126)]	A small tree or rigid shrub found in the Sub-Himalayan tracts from Rawalpindi district eastwards, ascending in Sikim up to 4,000 ft. Southwards it extends to Chittagong and the Peninsular India.	The fruits contain saponin in the pericarp, a glucosidic saponin in the pulp, and the seeds are said to contain traces of an alkaloid (95). An essential oil also present (18).	In Konkan the bruised fruit is mixed with grain to preserve it from the attacks of insects (26). Subramanyam (96) found that a 10 per cent aqueous extract of the root sprayed against the green scale of coffee gave an 80 per cent mortality of the insects in 4 days.





NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
129. <i>Polygonum hydropter</i> Linn.—(continued).		Root said to contain oxymethyl-anthraquinones (93).	are informed that it is used as a fish poison in the Punjab hills. It is very likely that some other plants belonging to the genus <i>Polygonum</i> , especially <i>P. persicaria</i> Linn., possess similar properties.
130. <i>Pongamia pinnata</i> (Linn.) Merr. (Syn. <i>P. glabra</i> Vent.)	A moderate-sized almost evergreen tree met with all over India, on the banks of rivers and streams, especially near the seacoast and some forest localities; often planted as a roadside tree. It sometimes flowers as a shrub on the seacoast.	The seeds contain 27 to 36.4 per cent of a bitter fatty oil and traces of an essential oil (18).	The seeds and roots are said to be poisonous to fishes. A 2 per cent <i>P. glabra</i> oil-resin spray has been stated to be highly toxic against the nymph and adult stages of the green bug ( <i>Coccus viridis</i> ) on coffee (94).
131. <i>Pygeum gardneri</i> Hook. f.	A medium-sized tree found in the Western Ghats of Madras and Bombay Presidencies, in the hills of Travancore, Malabar, Nilgiris, Pulneys, the Deccan, Southern Mahratta Country, and Konkan at altitudes above 3,000 ft.; common on the Mahableshwar plateau.	The seeds smell strongly of hydrocyanic acid.	The kernel of the fruit is used as a fish poison.
132. <i>Randia dumetorum</i> Lam. [Split up into three species by Gamble (126)]	A small tree or rigid shrub found in the Sub-Himalayan tracts from Rawalpindi district eastwards, ascending in Sikkim up to 4,000 ft. Southwards it extends to Chittagong and the Peninsular India.	The fruits contain saponin in the pericarp, a glucosidic saponin in the pulp, and the seeds are said to contain traces of an alkaloid (95). An essential oil also present (18).	In Konkan the bruised fruit is mixed with grain to preserve it from the attacks of insects (26). Subramaniyam (96) found that a 10 per cent aqueous extract of the root sprayed against the green scale of coffee gave an 80 per cent mortality of the insects in 4 days.
133. <i>Randia uliginosa</i> DC.	A small rigid tree found in the Eastern, Central and Southern India, but is not common northwards.	.....	The unripe fruit is used to intoxicate fish, and according to Watt (21), the bruised root is also employed for this purpose. The unripe fruits are employed for poisoning fish.
134. <i>Rauwolfia serpentina</i> Benth. ex Kurz	An erect shrub found in Sub-Himalayan tracts and in the plains near the foot of the hills from Sirbind eastward to Assam, ascending to an altitude of 4,000 ft.; also in Konkan, North Kanara, Southern Mahratta Country, Western and Eastern Ghats of the Madras Presidency (up to 3,000 ft.), many districts of Bihar such as Patna and Bhagalpur, and in North and Central Bengal.	Chemical analysis of the root has yielded five crystalline alkaloids which can be classified into two groups: (A) the <i>ajmaline</i> group—ajmaline, ajmalinine and ajmalicine; and (B) the <i>serpentine</i> group—serpentine and serpentinine (97). Besides these, there are some more alkaloids present in both the ajmaline as well as the serpentine group.	Pammel (17) records this plant as a fish poison, but such use has not been observed by the present authors in India.
135. <i>Rhododendron barbatum</i> Wall. ex G. Don	A tree found in the temperate Himalayas from Kumaon to Bbutan at altitudes of 8,000 to 12,000 ft.; common in Sikkim.	Contains the toxic substance andromedotoxin (88).	The plant is mentioned by Chopra (18) to be a fish poison.
136. <i>Rhododendron talconeri</i> Hook. f.	A tree common in the Himalayas from East Nepal to Bbutan at altitudes of 9,000 to 13,000 ft.	Contains a toxic substance, andromedotoxin (88).	Chopra (18) mentions the plant as a fish poison.
137. <i>Ricinus communis</i> Linn.	A tall stout annual, or perennial and sub-arborescent. Originally probably from America, it is now extensively cultivated for its oil-bearing seeds and has also become naturalized near habitations in many parts of India	Seeds contain a fixed oil and a toxalbumin, ricin, which does not pass into the oil (98).	Castor oil is said to be an active poison for flies (98). Pammel (17) records the plant as a fish poison.

125. <i>Pieris ovalifolia</i> D. Don	A small deciduous tree found in the outer Himalayas from the Indus eastwards, usually from 3,000 to 8,000 ft.; common east of the Ravi and in the Khasia Hills between 3,000 to 5,000 ft.	A toxic substance, andromedotoxin (88).	The young leaves are believed by people in Jammu to have insecticidal properties.
126. <i>Pithecellobium bigeminum</i> Mart. (Syn. <i>Pithecolobium bigeminum</i> ) Benth.)	A middle-sized unarmed tree found in the Eastern Himalayas, Khasia and Jaintia Hills, Konkan, North and South Kanara, the Western Ghats of Madras Presidency from Mysore to Anamalais and Travancore, ascending to an altitude of 3,000 ft.	The bark contains 0.8 per cent of an alkaloid, which acts as a fatal poison to fish in a dilution of 1 : 400,000 (89); it also contains a saponin (90). The leaves contain two acids but no alkaloids, glucosides or tannins (91).	The plant is poisonous to fish.
127. <i>Pogostemon heyneanus</i> Benth. (Syn. <i>P. panchoul</i> Hook f. in Fl. Brit. Ind., <i>non</i> Pellet.)	A strongly aromatic herb found in Western Ghats from South Kanara southwards, in open forest land; often cultivated and then run wild. Also about Kotagiri in the Nilgiris at 6,000 ft. Sometimes cultivated in gardens in the Bombay and Bengal Presidencies.	Essential oil.	The dried leaves are extensively employed for scenting linen and other clothes and to keep off insects from shawls, etc.
128. <i>Polygonum flaccidum</i> Meissn.	Common throughout India in wet places, ascending the Himalayas to 4,000 ft., and extending to Ceylon.	.....	It is locally used in Assam as a vermicide and as a fish poison. The greenish mucilaginous juice of the plant kills off mosquito larvae in 15 minutes, but it is not lethal in dilutions (124).
129. <i>Polygonum hydrioper</i> Linn.	A rather robust annual found in damp places more or less throughout India up to 7,000 ft. in the Himalayas.	The herb contains formic acid, acetic acid and baldrianic acid, much tannin and small amounts of an essential oil (92).	It is stated that insects avoid this plant; when dried and strewn among clothes it prevents the attacks of moths. The authors

NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
120. <i>Ougeinia dalbergioides</i> Benth.	A small or medium-sized tree found in the Sub-Himalayan tracts and outer Himalayan valleys and slopes up to an altitude of 5,000 ft. from the Punjab to Bhutan; also in Oudh, Bundelkhand, Chota-Nagpur, Central India, Orissa, the Circars, the Central Provinces, Bombay, and Marwar of Rajputana.	.....	The bark is employed to poison fish. The stem-bark and leaf are stated to be toxic to some caterpillar pests (56).
121. <i>Pachygone ovata</i> (Poir.) Miers <i>ex</i> Hook. f. & Thoms.	A lofty climber found in the sandy seashores of the Coromandel Coast from Nellore to Tanjore and Tinnevely; also in the Deccan in Bellary, Cuddapah and Mysore.	.....	The dried fruit is used for the purpose of destroying vermin and stupefying fish (16). Pammel (17) also records it as a fish poison.
122. <i>Peganum harmala</i> Linn.	A densely foliaged bushy herb, common in the drier waste places and fields of Baluchistan, Waziristan, Kurrum Valley, Sind, Cutch, the Punjab, Kashmir, Delhi, United Provinces, Bihar, Konkan and the Western Deccan.	Seeds contain the alkaloids harmine, harmaline, harmalol and peganine (86); also a soft resin (21).	The smoke of the plant is commonly used in the Punjab as a disinfectant-fumigant, and is believed to keep off mosquitoes. According to Watt (21), the powdered root, mixed with mustard oil, is applied to the hair to destroy vermin. Pammel (17) records the plant as a fish poison.
123. <i>Phyllanthus urinaria</i> Linn.	An annual or rarely perennial herb found throughout the plains of India from the Punjab to Assam and Madras Presidency up to an altitude of 3,000 ft.	The plant is said to contain a neutral bitter substance and an alkaloidal principle (26).	
124. <i>Picrasma javanica</i> Blume, var. <i>nepalensis</i> (Benn.) Badhwar <i>nov. comb.</i> (Syn. <i>P. nepalensis</i> Benn.)	A moderate-sized tree found in Assam and Nepal.	.....	We are informed that the powdered young leaves and the twigs of this plant are used as a larvicide in Assam.





NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
120. <i>Ougeinia daibergloidea</i> Benth.	A small or medium-sized tree found in the Sub-Himalayan tracts and outer Himalayan valleys and slopes up to an altitude of 5,000 ft. from the Punjab to Bbutan; also in Oudh, Bundelkhand, Chota-Nagpur, Central India, Orissa, the Circars, the Central Provinces, Bombay, and Marwar of Rajputana.	.....	The bark is employed to poison fish. The stem-bark and leaf are stated to be toxic to some caterpillar pests (56).
121. <i>Pachygone ovata</i> (Poir.) Miers ex Hook. f. & Thoms.	A lofty climber found in the sandy seabores of the Coromandel Coast from Nellore to Tanjore and Tinnevely; also in the Deccan in Bellary, Cuddapah and Mysore.	.....	The dried fruit is used for the purpose of destroying vermin and stupefying fish (16). Pammel (17) also records it as a fish poison.
122. <i>Peganum harmala</i> Linn.	A densely foliated bushy herb, common in the drier waste places and fields of Baluchistan, Waziristan, Kurrum Valley, Sind, Cutch, the Punjab, Kashmir, Delhi, United Provinces, Bihar, Konkan and the Western Deccan.	Seeds contain the alkaloids harmine, harmaline, harmalol and peganine (86); also a soft resin (21).	The smoke of the plant is commonly used in the Punjab as a disinfectant-fumigant, and is believed to keep off mosquitoes. According to Watt (21), the powdered root, mixed with mustard oil, is applied to the hair to destroy vermin.
123. <i>Phyllanthus urinaria</i> Linn.	An annual or rarely perennial herb found throughout the plains of India from the Punjab to Assam and Madras Presidency up to an altitude of 3,000 ft.	The plant is said to contain a neutral bitter substance and an alkaloidal principle (26).	Pammel (17) records the plant as a fish poison.
124. <i>Picrasma javanica</i> Blume, var. <i>nepalensis</i> (Benn.) Badhwar nov. comb. (Syn. <i>P. nepalensis</i> Benn.)	A moderate-sized tree found in Assam and Nepal.	.....	We are informed that the powdered young leaves and the twigs of this plant are used as a larvicide in Assam.
125. <i>Pieris ovalifolia</i> D. Don	A small deciduous tree found in the outer Himalayas from the Indus eastwards, usually from 3,000 to 8,000 ft.; common east of the Ravi and in the Khasia Hills between 3,000 to 5,000 ft.	A toxic substance, andromedotoxin (88).	The young leaves are believed by people in Jammu to have insecticidal properties.
126. <i>Pithecellobium bigeminum</i> Mart. (Syn. <i>Pithecolobium bigeminum</i> ) Benth.)	A middle-sized unarmed tree found in the Eastern Himalayas, Khasia and Jaintia Hills, Konkan, North and South Kanara, the Western Ghats of Madras Presidency from Mysore to Anamalais and Travancore, ascending to an altitude of 3,000 ft.	The bark contains 0.8 per cent of an alkaloid, which acts as a fatal poison to fish in a dilution of 1: 400,000 (89); it also contains a saponin (90). The leaves contain two acids but no alkaloids, glucosides or tannins (91).	The plant is poisonous to fish.
127. <i>Pogostemon heyneanus</i> Benth. (Syn. <i>P. pathouli</i> Hook f. in Fl. Brit. Ind., non Pellet.)	A strongly aromatic herb found in Western Ghats from South Kanara southwards, in open forest land; often cultivated and then run wild. Also about Kotagiri in the Nilgiris at 6,000 ft. Sometimes cultivated in gardens in the Bombay and Bengal Presidencies.	Essential oil.	The dried leaves are extensively employed for scenting linen and other clothes and to keep off insects from shawls, etc.
128. <i>Polygonum flaccidum</i> Meissn.	Common throughout India in wet places, ascending the Himalayas to 4,000 ft., and extending to Ceylon.	.....	It is locally used in Assam as a vermicide and as a fish poison. The greenish mucilaginous juice of the plant kills off mosquito larvae in 15 minutes, but it is not lethal in dilutions (124).
129. <i>Polygonum hydropter</i> Linn.	A rather robust annual found in damp places more or less throughout India up to 7,000 ft. in the Himalayas.	The herb contains formic acid, acetic acid and baldrionic acid, much tannin and small amounts of an essential oil (92).	It is stated that insects avoid this plant; when dried and strewn among clothes it prevents the attacks of moths. The authors

117. <i>Nicotiana tabacum</i> Linn.	An erect herb cultivated throughout India; sometimes met with as an escape.	Leaves, stems and roots contain volatile alkaloid, nicotine. Leaves also contain several other alkaloids (86), and two glucosides (87).	Preparations from the leaves and crude solutions of nicotine are extensively employed as insecticides in horticulture by dusting or spraying or by vaporization. Similar preparations are sometimes used for external application and as parasitocides in veterinary practice. Tobacco leaves are also used to ward off leeches, for which purpose they are placed under the stockings during marches in damp forest localities that are infested with these pests.
118. <i>Nigella sativa</i> Linn.	A pretty herb extensively cultivated in many parts of India for its seeds.	Seeds stated to contain 0.5 to 1.4 per cent of an essential oil and a saponin-like glucoside, melanthin.	It appears to be a common practice in India to scatter the seeds between the folds of linen or woollen clothes to prevent them from being eaten by insects.
119. <i>Ocimum gratissimum</i> Linn.	Cultivated in gardens throughout Bengal, East Nepal and the Deccan Peninsula; said to be a common wild plant in Western India.	Essential oil, thymol, eugenol, methyl chavicol (18).	The shrubby basil is popularly believed to be a good mosquito repellent and its plantation has been suggested as a measure of biological control of mosquitoes; it diffuses a stronger fragrance than any other member of the genus <i>Ocimum</i> . In this connection it may be remarked that <i>O. sanctum</i> Linn. is also believed to have similar properties.

NAME OF PLANT	DISTRIBUTION	CONSTITUENTS	REMARKS
113. <i>Mandulea sericea</i> (Willd.) Greenway (Syn. <i>M. suberosa</i> Benth.)— <i>(continued.)</i>			driving them away from the river. He also states that the people of Tanganyika sometimes tie the strips of bark round the legs of the cattle, when they are taken to the river to water, in order to protect them from these reptiles. It is very likely that the root is also poisonous to fish.
114. <i>Myrica nagi</i> Thunb.	A small evergreen dioecious tree found in the outer Himalayas from the Ravi eastwards at altitudes of 3,000 to 6,000 ft.; also in the Khasia Hills and Sylhet.	According to Hooper, 100 parts of the 'kino' produced by the bark contain about 60 to 80 parts of tannin (20).	According to Gamble (85), the bark is used in the Khasia Hills to poison fishes.
115. <i>Nicandra physaloides</i> Gaertn.	An erect annual herb introduced from Peru, but now found as a weed on rich soils in many parts of India up to 7,000 ft. on the Himalayas; often grown in gardens.	.....	In Madagascar, a decoction of the leaf is stated to be used to destroy <i>Pediculus capitis</i> (16). It is also stated to be used as a fly poison in parts of the United States of America (17).
116. <i>Nicotiana rustica</i> Linn.	An erect herb cultivated in Western Punjab, Baluchistan, Bengal and other places in India, but sparingly as compared with <i>N. tabacum</i> .	See <i>N. tabacum</i> .	Properties similar to <i>N. tabacum</i> .



